

CALCIFIED WOOD FOUND IN UPLAND SAND NEAR CINCINNATI.*

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INTRODUCTION.

The specimens of calcified wood here reported are of interest for three reasons. Because of the pronounced crystallization habit of calcite, cell structure is usually obliterated by the crystal growth. For this reason, the replacement of wood structure by calcite has seldom been reported.^{1, 2} A case of partial replacement of wood by dolomite is reported by S. F. Adams.³ In the petrified wood here noted, the wood structure is imperfectly preserved and fragmentary, but sufficiently clear for identification as a gymnosperm.

Another point of interest is the probable age of the wood. The sand in which it is found may be of late Tertiary age as inferred by Dr. Leverett,⁴ but it seems more likely to be of pre-Illinoian Pleistocene age. Calcified wood as recent as the Pleistocene has not been reported, as far as known to the writer.

In addition, the position of the water-laid sand is interesting. It occurs on the upland a mile and a half south of the Ohio River and a mile and a half west of the valley rim of the Licking River at an elevation of 390' to 400' above the present water level.

PHYSICAL CHARACTER OF WOOD FRAGMENTS.

The wood specimens are of two sizes. The smaller pieces are 3 or 4 inches long and about one inch in diameter (Fig. 1), and the larger are 8 to 12 inches long and 4 to 6 inches in diameter. (Fig. 2). The smaller are calcified throughout with a brown limonite stain along the annual rings and on the outside surface, which resembles bark. The wood fragments

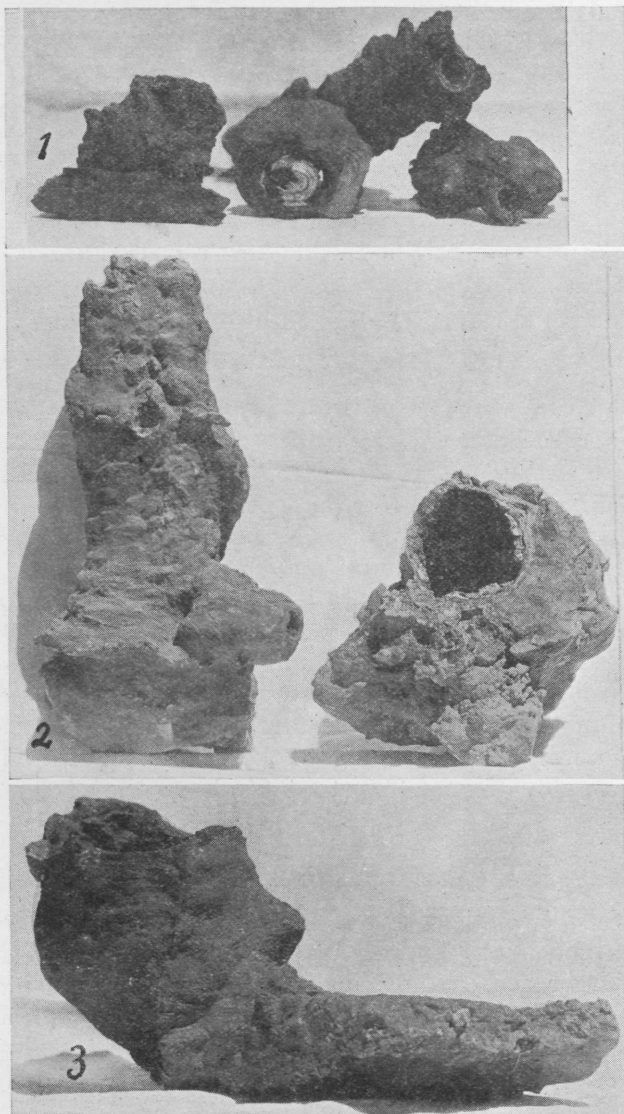
*Presented in part before the Ohio Academy of Science, April 19, 1930.

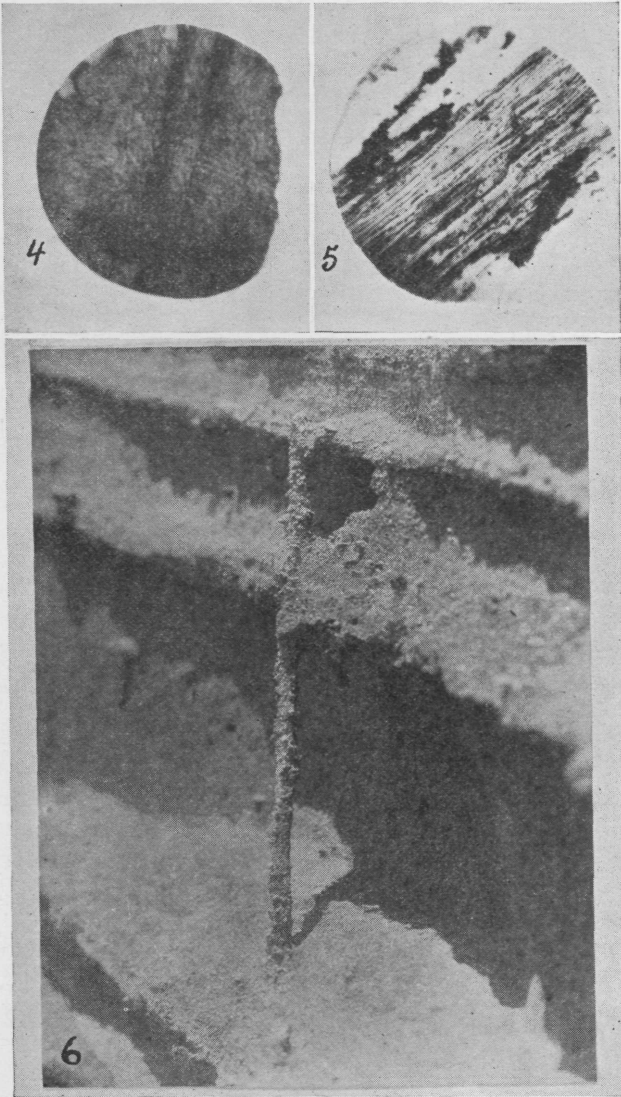
¹Greenland, C. W., *Economic Geology*, Vol. 13, 1918.

²Wherry, E. T., *Proc. U. S. National Museum*, Vol. 53, June, 1917.

³Adams, S. F., *Journal of Geology*, Vol. 28, 1920.

⁴Leverett, Frank, *Kentucky Geological Survey*, Series VI, Vol. 31.





are in part hidden by cemented sand clinging in concretionary form. The smaller specimens occur in generally horizontal position projecting from the deposit. The larger pieces are merely shells of limonite with the central portion missing altogether except where broken-off branches project, and these are filled with calcite.

The large shells appear to stand in upright position, and one which had been thrown aside by the workmen and was not seen in place, stands at right angles to a flat, cemented layer which one would expect to be approximately horizontal. (Fig. 3).

There is no cell structure preserved in the larger specimens, so they are of interest chiefly because the relative position of the two kinds of fossils suggests that the smaller are branches of the larger, especially since the latter have broken branches of about the same cross section as the small pieces. The fossilization in the smaller specimens is so imperfect that it cannot be said whether we are dealing with stems or roots. It seems unlikely that they are modern roots which have penetrated from the present surface which is 12 or 15 feet above and separated from the sand by a heavy layer of calcareous and limonitic cement.

MICROSCOPIC CHARACTERS.

From what seemed the best specimen of wood, fourteen thin sections have been made for examination under the microscope. These include five cross-sections, five tangential sections, and four radial sections. The cell structure as exhibited in the cross sections is very imperfect, but seems to show (Fig. 4) that the wood is without the pores or vessels which all angiosperms show. This would identify the wood as that of a gymnosperm. In radial section the tracheids are not clear enough to make certain whether the pits are bordered as in all gymnosperms or not. In tangential section the ends of the medullary rays are clear in several cases and these are undoubtedly uniseriate (Fig. 5) which is characteristic of many gymnosperms, though not diagnostic.

Closer than this, the identification seems impossible from the sections at hand. Before the specimen was ground, both Dr. Walter Bucher, of the Geology Department of the University of Cincinnati, and Dr. John Hoskins, of the Botany Depart-

ment, thought the general appearance of the wood was like that of a cedar. Nothing in the microscopic examination is contrary to this, though a definite identification is not possible.

DEPOSIT IN WHICH THE WOOD WAS FOUND.

The fragments of wood were found in an 8- to 10-foot deposit of very fine sand on the upland a little more than one mile south of Covington, Kentucky at an elevation of approximately 820' A. T. The sand is very fine with scattered tiny chert pebbles, partly cross-bedded, with bedding planes outlined in brown, and very calcareous throughout. In this fine material occur abundant concretions of random shapes and enormous proportions, in addition to the many specimens of calcified wood, themselves forming nuclei of concretions. The sand is being removed for sale as molder's sand in aluminum and brass work, its per cent of calcium carbonate being too high for use in molding iron.

At the top of the bed of sand is a cemented zone 8 to 10 inches thick which is largely calcium carbonate, but also partly limonite. In some places, the cement is quite solid throughout and in places it is made up of fragmentary beds separated by unconsolidated material. These consolidated layers separate the lower deposit from a succession of coarser water-laid beds above, in places calcareous and in places leached, which appear to be composed of succeeding layers of greatly decomposed gravels and clean sand, with one thin band of boulder clay. The reason for the band of cemented material seems clear from the fact that the sand below grades into a foot or more of the finest silt toward the top, immediately beneath the present zone of cementation. This is followed above by the coarser, pebbly sand and gravel. When the deposit was first excavated there appeared in the gravel one band of boulder clay about six inches thick with ten or fifteen feet exposed laterally. In the absence of any other boulder clay in any other exposure in the neighborhood, the band of ice-laid material was interpreted as due to a floated ice block. This has been supported by the entire disappearance of the band of till since the excavation has been cut farther back, and by its failure to appear in a new excavation in the same deposit at a little distance from the first digging.

DEPOSIT OF DECOMPOSED GRAVEL.

At a higher level, up to 900', but apparently continuous with this deposit, is a greatly decomposed gravel, dark brown and streaked with black stains, which is leached to a depth of 18 to 20 feet so that it does not effervesce with weak hydrochloric acid. This deposit has abundant pebbles up to three inches in diameter, though mostly small, and many are so decomposed that they crumble to powder in one's fingers. The pebbles are largely of chert and quartz, though many of quartzite, granite, gneiss and basalt were also found. It is the granite and gneiss pebbles which are so greatly decomposed and these give off strongly the odor of kaolin. The pebbles lie in a matrix of clayey material, the result, probably, of their own decomposition and not like boulder clay. Besides, there are no boulders. The material is decomposed gravel, not boulder clay. The deposit is being cut away and screened, for use as molder's sand in molding iron. This deposit seems to correlate with an exposure at the same level on the Dixie Highway about half a mile distant and three quarters of a mile northeast of Ft. Mitchell. Here the material is largely sand showing horizontal bedding planes.

From the top of the leached gravel to the base of the sand in which the calcified wood was found, there is a difference in elevation of 75 feet as measured with the aneroid, and the two kinds of material appear to be a continuous deposit down the slope of the hill. The sand is said to rest on clay below, but this is not exposed.

PRE-GLACIAL EROSION SURFACES.

Glacial sand and gravel on the upland 390' to 465' or 470' above the present drainage (Licking River at 430' two miles east, Ohio River at 430' one and a half miles northwest) points, of course, to a time in the Pleistocene when the drainage of the region was at that level. It is believed, however, that the level on which the deposit now rests was at the time of deposition at a lower altitude. That there are high-level benches in this vicinity representing old valley floors antedating the present rejuvenated streams will be discussed in a later paper. Of these, the old 800'-820' erosion surface, the highest of such benches in this vicinity, is represented by prominent shoulders, clearly to be seen in the field. The ridge southwest of Covington

has on both sides ridge-like shoulders extending out toward the valleys, which are remnants of this old bench along the old drainage lines. These fragments of the same level present on the map the characteristic pattern of a dissected terrace. The sand where the wood was found rests on one of these shoulders.

The 800'-820' valley floor is succeeded at about 700'-720' by another level which also extends tongues of land out toward the valleys, less prominently in this exact location than elsewhere in the Cincinnati quadrangles. There are reasons for believing that both these benches probably existed above the drainage in early Pleistocene time, but that the present trenching of the rivers has taken place since, as stated by Dr. Leverett.⁵ Such benches, if they did exist, would be apt to receive and hold a river-laid deposit at any time of unusual flooding.

AGE AND ORIGIN OF DEPOSITS.

To review the evidence for reconstructing the history: The sand where the wood fragments were found is very fine, grading into a powdery silt at the top and it has no pebbles except tiny ones of chert. This is separated from the gravel and sand above by the zone of calcareous cement. The gravel is without any doubt of glacial origin. The events interpreted from these facts might well have been as follows: As the ice from the north advanced, the Licking, or some other north-flowing stream of this region, was dammed, causing it to deposit sand followed by silt as the current slackened to none at all. This was followed by an invasion of outwash from the ice front. If the upright position of the tree trunks be more than accidental, they may have been buried in place as the flooding waters encroached on the higher levels. The outwash material at 900' marks the relative level to which the glacial waters rose.

If this break in the kind of material at the cemented layers can be interpreted as given above, the sand and the included calcified wood would be of Pleistocene age. The glacial material above the river sand and clay would have furnished the lime for the cement which has been localized by the contact with silt, as well as for the concretions and the calcified wood.

As to the age more exactly. The upper deposit of decomposed gravel—not immediately in contact with the sand and silt—but higher up the slope (880'-900'), as mentioned above,

⁵Leverett, Frank, loc. cit.

is leached to a depth of 18 to 20 feet, whereas gravel of Illinoian age exposed at the surface at Mariemont just north of the Ohio River is leached only 8 to 10 feet below the surface. This would seem to signify that the age of the gravel is pre-Illinoian as given by Dr. Leverett.⁶ Dr. Leverett, however, speaks of the material on this ridge as drift and till. Only one narrow band of till, later removed by excavation, has been seen by the writer. The whole ridge as far as exposures furnish data would seem to be covered with outwash of a pre-Illinoian glacier rather than by till.

OTHER CALCIFICATIONS IN PLEISTOCENE SAND.

In Cincinnati in a valley deposit of accepted Illinoian age, shells of two tree trunks or large branches were found at the level of a cemented zone between outwash below and boulder clay above. These were in appearance like the larger specimens found in Kentucky and seem to the eye unlikely to show any cell structure under the microscope. Their position was horizontal. The exposure is on Este Avenue just north of Ivorydale.

Another mode of calcification was observed in the same deposit in very fine sand at a place where the zone of cement was missing between the sand below and boulder clay above. Rootlets, evidently modern, had penetrated from the surface and when exposed in the excavation for sand showed a white encrustation of lime. (Fig. 6). Also fault planes, evidently due to slumping when the very fine sand was wet, were accentuated by planes of calcareous deposit projecting slightly beyond the steep slope of sand. Many rootlets had also taken advantage of the space along the fault planes and these, too, were encrusted with lime. So calcification of a sort seems to require no great length of time.

⁶Leverett, Frank, loc. cit.